INEEL/CON-99-01310
PREPRINT

IDAHO NATIONAL ENGINEERING & ENVIRONMENTAL LABORATORY

The Pit and the Safety Pendulum

R. L. Nitschke
A. G. Ramos

November 27, 2000 – December 1, 2000

International Conference on Probabilistic Safety Assessment and Management (PSAM 5)

BECHTEL BWXT IDAHO, LLC

The Pit and the Safety Pendulum[a]

Robert L. Nitschke
Idaho National Engineering and Environmental Laboratory, P.O. Box 1625, Idaho Falls, ID 83415-3960 rln@inel.gov
Amadeo G. Ramos
Idaho National Engineering and Environmental Laboratory, P.O. Box 1625, Idaho Falls, ID 83415-3960 ar4@inel.gov

Abstract

The hypothesis of this paper is that the safety analysis pendulum has swung considerably in the direction of increasingly complex and lengthy safety evaluations and intense reviews during the past 30 years. The test of this hypothesis will be a review of the safety analysis conducted for various activities associated with the retrieval of transuranic radioactive waste from burial pits at a National Laboratory site over a span of 30 years. The examination will focus on the safety aspects and the safety analysis that was conducted for the projects. At the conclusion of this examination, the paper will identify five reasons why the changes have taken place.

1. INTRODUCTION

The hypothesis of this paper is that the safety analysis pendulum has swung considerably during the past 30 years. To test this hypothesis, we review the safety analysis conducted for various activities associated with the retrieval of transuranic radioactive waste from burial pits at a National Laboratory site. We evaluate these various projects with specific attention devoted to the pertinent safety analyses. A few words are in order on why this particular set of activities is being examined. One reason is that the interest in the retrieval of buried transuranic radioactive waste is still current. Secondly, the interest began around 1970 when the Atomic Energy Commission, the predecessor to the Department of Energy, decided to no longer dispose of transuranic radioactive waste in shallow land burial grounds. Thirdly, this thirty-year period gives ample opportunity to see what activities have been conducted and to see how the associated safety analysis has progressed. Of note, one drawback in trying to examine a thirty-year period is finding the necessary documentation. As projects are completed, and programs are ended, as contractors and organizations change, as personnel change jobs and retire and as the record retention requirements change, finding the needed information is a challenge in itself. In some cases, it was necessary to resort to circumstantial evidence. And in fact, cost, schedule, and volume of paper can all be indirect indicators of the rigor of safety analysis performed.

2. EVALUATION

Project 1. The quest starts with a 1971 project. The Atomic Energy Commission requested that a series of waste retrieval tests be conducted to gain insight into the problems that may arise in a large scale exhuming operation.(1) The results of these tests demonstrated the feasibility of retrieving solid waste from a burial ground and that the retrieval could be done safely. The actual work consisted of the movement of almost 800 barrels of waste with 16 drums retrieved and prepared for hot cell examination. The work involved the initial use of a backhoe with the final soil and drums removed by hand. The excavation crew consisted of one or two laborers, an equipment operator, a health physicist and a technical man. With respect to the safety analysis, there was a **two-page** analysis of five safety considerations: fire, criticality, direct radiation hazard, inhalation radiation hazard, and contamination spread. This analysis generally described the hazards and the proper steps to take to address the concerns. The actual work in the field was conducted using detailed operating procedures. But in 1971 a detailed excavation and transportation procedure consisted of only **seven** pages. The schedule allowed two weeks for a safety review. The required safety equipment consisted of a radio, 4 kinds of fire extinguishers, a GM instrument for beta- gamma, a Ludlum instrument for alpha, hard hats and safety glasses, anti-c clothing, full face masks, and a portable eye wash.

Project 2. The second project began in 1974 and lasted 4 years.(2) The purpose of this project was to demonstrate the safe retrieval, packaging, and storage of recently buried drums containing transuranic contaminated waste. A total of 20,262 drums were eventually retrieved. The retrieval operations were completed without serious injury or spread of contamination into the environment.(3) The working crew consisted of an HP technician, a project foreman, an equipment operator, a heavy equipment operator, and a laborer.

For this project we were unable to locate any specific safety analysis. We suspect that the success of the previous program in terms of safety contributed considerably to not requiring any in-depth safety analysis. The operating procedure description states that workers were provided with anti-contamination coveralls and gloves, hard hats, safety shoes, shoe covers, and respirators. “Respirators are not worn during routine operations, but are available as an escape device should an airborne release occur.” The entire program spent approximately $80 per drum.

Project 3. The next project evaluated was conducted at the same time as Project 2. This project had as its purpose to develop environmental and safety information as well as the technology needed for retrieval of early buried transuranic contaminated waste.[4] In this case, all of the waste had been underground for at least 14 years. Due to the expected deteriorated condition of the waste containers, this is the first time that a containment structure was proposed for contamination control. Although we were unable to locate the original SAR; a program plan states that “This safety analysis evaluates all known safety considerations for the project and defines the safety measures that will be taken to preclude endangering any personnel during the retrieval operations. This safety analysis was reviewed and approved by ANC and ERDA Safety departments before retrieval operations began.”[4] The project schedule showed 9 months for preparing and approving both the safety analysis and the operating procedures. The health and safety considerations included fire, direct radiation hazards, contamination controls, criticality, and toxic chemical materials. This is also the first case in which specific training (health physics radiation worker training, fire fighting, equipment operation, as well as specific training for handling plutonium waste) was provided for the workers. This is also the first time that an environmental assessment was conducted. In 1976, this assessment consisted of three pages with only one devoted to the probable environmental effects.

There is some insight into how an Unreviewed Safety Question was addressed at that time. The first two drums retrieved were badly deteriorated and breached to the point that they fell apart upon retrieval. Markings on these two drums and the next six drums retrieved read “Cluster Fragmentation Bomb.” The safety division was notified and retrieval operations were discontinued until a course of action and special handling procedures could be developed to handle the drums.[5] Approved procedures for handling the drums labeled “Cluster Fragmentation Bomb” were received, reviewed, and implemented **two** months after the initial discovery.

Project 4. The next project occurred in 1978 and involved the penetration and removal of transuranic radioactive drums from a buried waste storage area. The project determined the condition of the drums and whether the drums would meet the 20-year storage criteria.[6] This project removed 102 drums.

Once again no specific safety analysis was found. The removal of the drums was conducted in the open air. A safety barrier was erected with safety instruction signs located around the excavation sites. A barrier also bound the penetration areas with signs bearing health physics entrance requirements. Personnel exposure during the penetration was negligible.

Around this same time the level and degree of safety analysis began to increase dramatically. A study entitled "Environmental and Other Evaluations of Alternatives for Long-Term Management of Buried Transuranic Waste"(7) considered both exposures during normal operations as well as during accidents to not only the worker but also to the maximum individual and to the population. This study considered a wide variety of accident scenarios including volcanoes, earthquakes, flooding, tornadoes, fires, criticality, aircraft crash and inadvertent intrusion. The study addressed both acute and chronic impacts.

In May of 1989, the first use of probabilistic risk assessment techniques for the evaluation of the excavation and retrieval of buried transuranic waste was conducted. This effort was limited to those required by a Level 1 PRA; i.e., to determine the existence of risk, not the magnitude or consequences.(8) The analysis was further limited in that there was only a conceptual design for the retrieval. The work helped to identify improvements to the conceptual design to minimize risk and to determine where unnecessary precautions had been incorporated.

Project 5. The next project evaluated took place in 1989 and penetrated, inspected, and removed buried waste drums from an aboveground storage pad. As with many of the previous projects, the purpose was to gather information to support additional buried waste retrieval efforts. The waste removed for this project had been interred for at least 10 and less than 20 years.

In this case a stand-alone safety assessment document and health and safety plan was prepared.(9) The requirements of these documents were implemented by a set of operational safety requirements. The safety assessment evaluated five hazards in detail. These were criticality, chemical, explosion, fire, and radiological. The safety assessment was over 120 pages long and established the safety basis for the operation. For the next ten years, no actual fieldwork was attempted. However, many studies continued, each becoming more and more analytically robust.

Project 6. The Comprehensive Demonstration Project was developed in 1992 to retrieve, treat, and store the buried transuranic waste. The preliminary safety analysis report (PSAR) was scheduled to be complete by January 1993 with full-scale production scheduled to start February 1994. In January of 1995, the PSAR was still in the review process. The safety basis documented in the PSAR was never approved. A similar set of hazards were identified as in past retrieval and penetration projects. The hazards were criticality, natural phenomena, fires, and explosions. After many engineering analyses, documented safety analyses, and construction of multi-million dollar structures, the subcontract was cancelled. The risk evaluated and the level of rigor imposed on the safety analysis never met contractual requirements.

Project 7. In 1997, a staged interim action project was initiated for the buried waste area discussed in Project 6. The project was to remediate the buried waste areas and evaluate remedial options for other similar buried waste areas. The approach was to execute work in three stages. The purpose of the first stage was to explore the subsurface to obtain data from a portion of buried waste area before the second phase, a limited excavation and retrieval to a depth of 6m. The last stage would remove the remaining buried waste. The first stage had two distinct activities: (1) installation of probes and downhole geophysical logging, and (2) coring, sample retrieval and analysis, and bench scale treatability studies. Two separate safety analyses were prepared. Additionally, the entire first stage was independently evaluated by an independent technical review panel.(10) The probing and downhole logging safety analysis was extensive considering that no retrieval was planned. The hazards evaluated were criticality, explosion, and fire. A hydrogen pressurized buried drum was evaluated for the frequency of a puncture from a probe and its consequences (even though previous projects indicated drum corrosion). After two years of extensive analyses and reviews, probing into the buried waste was authorized. The coring preliminary safety analysis(11) was in development for approximately two years before being placed on hold due to risk, complexity, cost and extended schedule. The analysis was extensive and complex. The results of the safety analysis drove the estimated cost of the drill string enclosure significantly over budget. It was decided that coring was too costly and not worth the risk. The Stage II preliminary safety analysis(12) was in development for less than one year. Although no formal approval was granted for the preliminary analysis, the DOE concurred with the analysis documents. The project as well as the third stage has been shelved until other remedial technologies are evaluated.

3. SUMMARY AND CONCLUSIONS

It is clear from the examination of these similar projects spanning a period of almost thirty years that the safety analysis pendulum has swung considerably in the direction of increasingly complex and lengthy safety evaluations and intense reviews. Reasons for this change in safety analysis rigor are many. The first reason is that the requirements and expectations for safety analysis have become more demanding. The second reason is that safety analysis process and the tools available to conduct such analysis have evolved and become much more robust. Another reason is that there is a greater understanding of the hazards involved. Yet another reason is that while the activity (retrieval of buried waste) has not changed, the task has become more difficult due to things like container degradation. Lastly, there is greater scrutiny of these activities and these scrutinizers are less tolerant of any mishaps.

Since even the early projects with minimal safety analysis were conducted safely and without any significant incidents, it is difficult to determine just where the value added of the additional safety analysis begins and ends. Most analysts today would agree the analyses conducted in the early years was minimal and certainly below today's standards. It is not clear just what agreement, if any, would be reached on the latest breadth and depth of analysis being conducted for today's retrieval activities. Since this determination involves value judgments in addition to technical rationale, the authors will leave it to the readers to form any conclusions they wish on whether the safety analysis pendulum has swung too far.

4. REFERENCES

1. ACI-120, Solid Radioactive Waste Retrieval Test, May 1972
2. TREE-1079, Initial Drum Retrieval Interim Report, May 1977
3. TREE-1286, Initial Drum Retrieval Final Report, August 1978
4. WMP-76-01 Rev. 4, Program Plan for Early Waste Retrieval, Oct. 1976
5. TREE-1321, Early Waste Retrieval Final Report, August 1979
6. TREE-1311, Jan.1979 Transuranic Storage Cell Penetration & Inspection
7. IDO-10085, December 1979, Environmental and Other Evaluations of Alternatives for Long-Term Management of Buried Transuranic Waste
8. EGG-WM-8527, May 1989, Buried Waste Program PRA Level One
9. WM-PD-86-011, Rev. 2, June 1989, Safety Assessment for the Pad A Penetration
10. Independent Technical Review of Proposed Drilling Activities for Operable Unit 7-10 Staged Interim Action, September 1999
11. INEEL/EXT-98-00181, January 2000, Preliminary Safety Assessment for the OU 7-10 Staged Interim Action Project Stage I, Phase II
12. INEEL/EXT-99-00013, January 2000, Preliminary Safety Assessment for the OU 7-10 Staged Interim Action Stage II

[a] Work supported by the U.S. Department of Energy, under DOE Idaho Operations Office Contract DE-AC07-99ID13727